FIG.1

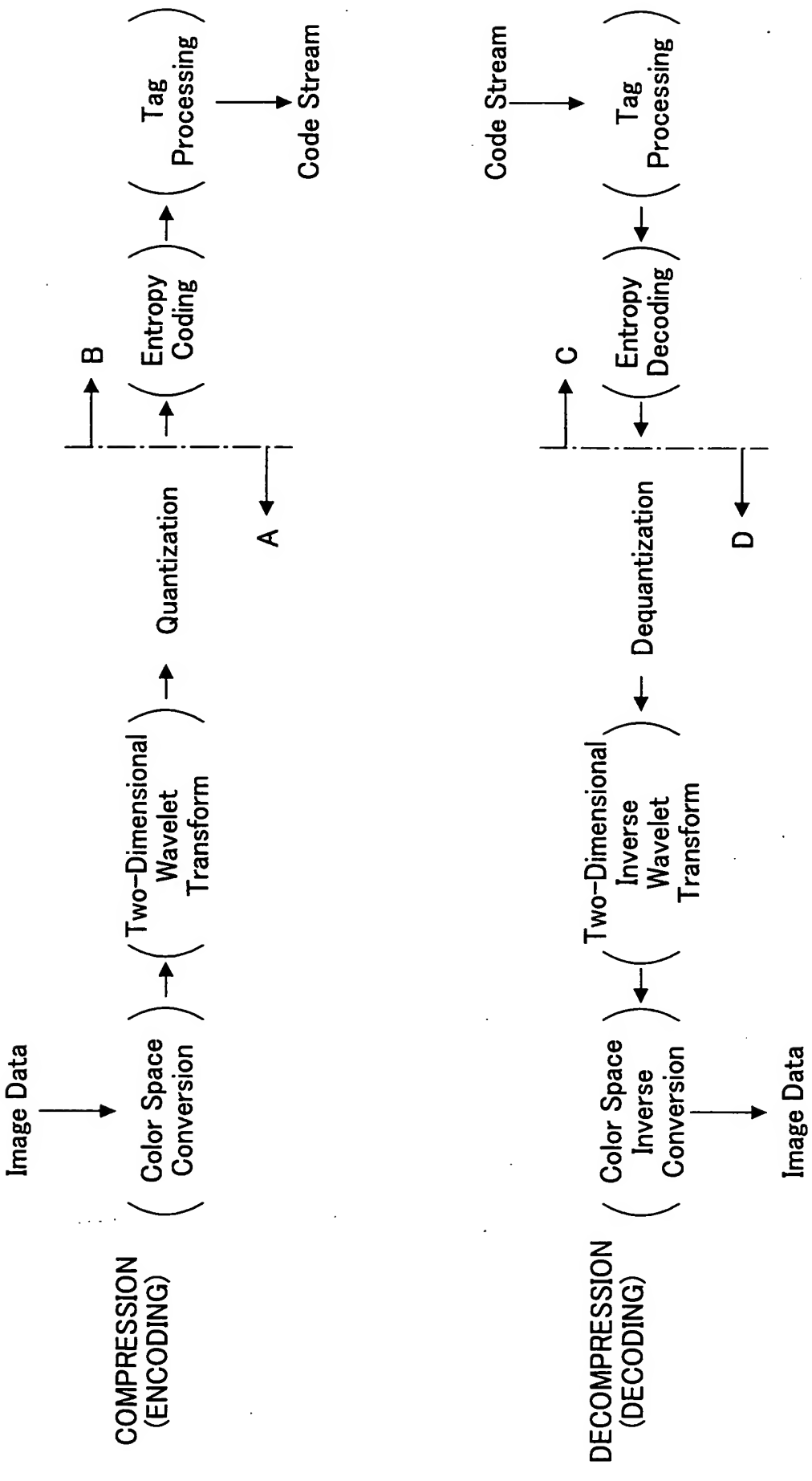

COMPRESSION (ENCODING)
Image Data
Color Space Conversion
Two-Dimensional Wavelet Transform
Quantization
A
B
Entropy Coding
Tag Processing
Code Stream
DECOMPRESSION (DECODING)
Code Stream
Tag Processing
C
Entropy Decoding
D
Dequantization
Two-Dimensional Inverse Wavelet Transform
Color Space Inverse Conversion
Image Data

FIG.2

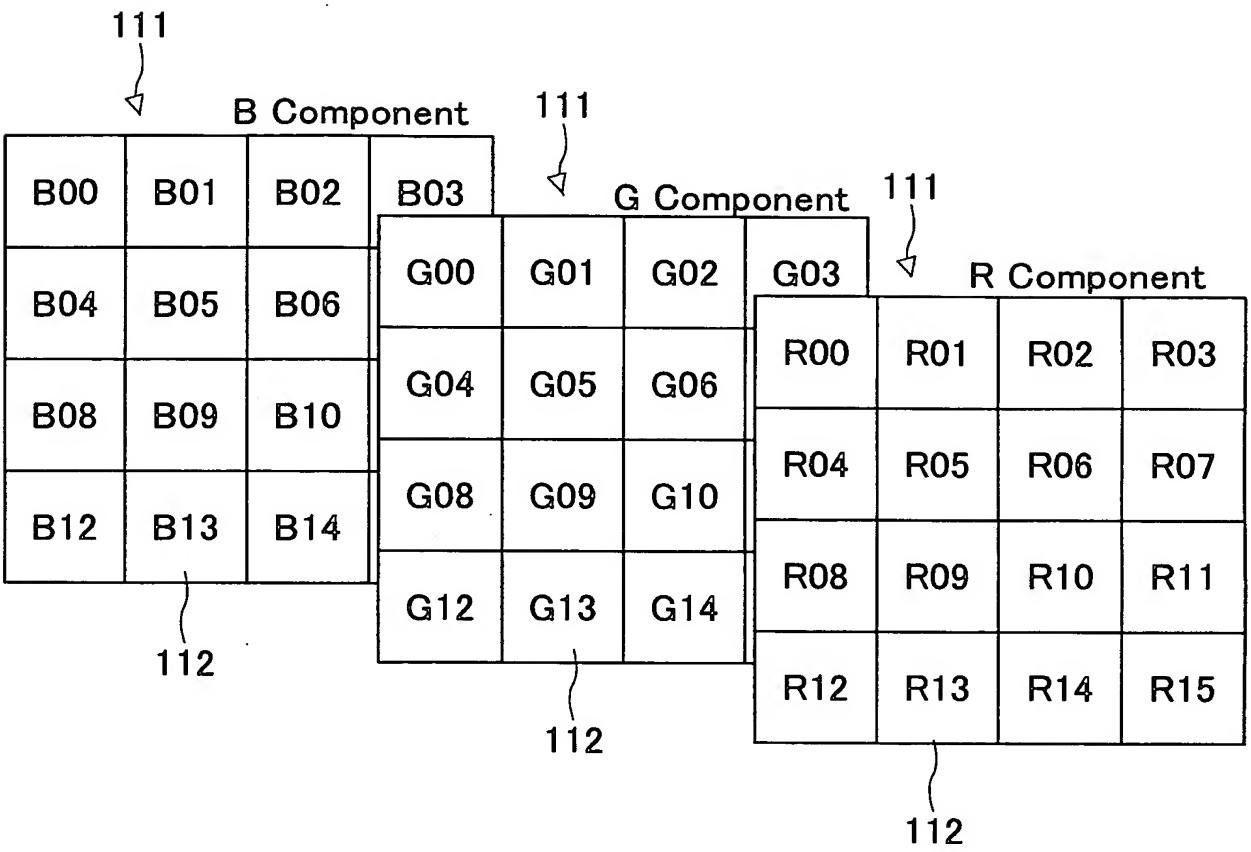
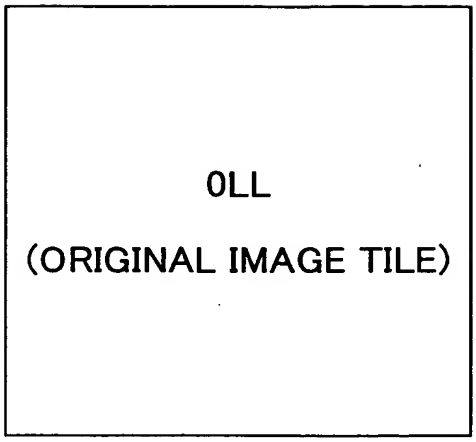
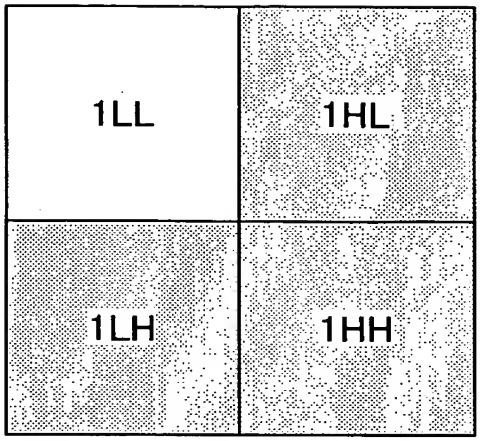

111
B Component
111
G Component
111
R Component
B00
B01
B02
B03
B04
B05
B06
B08
B09
B10
B12
B13
B14
G00
G01
G02
G03
G04
G05
G06
G08
G09
G10
G12
G13
G14
R00
R01
R02
R03
R04
R05
R06
R07
R08
R09
R10
R11
R12
R13
R14
R15
112
112
112

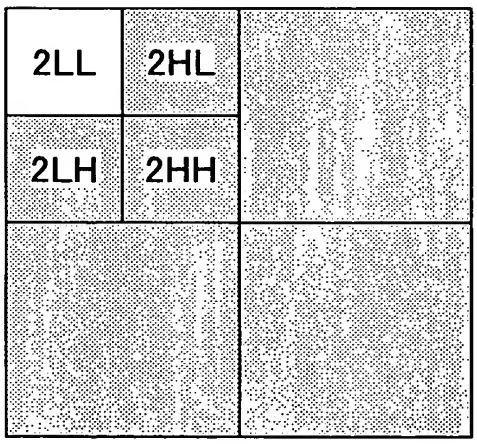
FIG.3



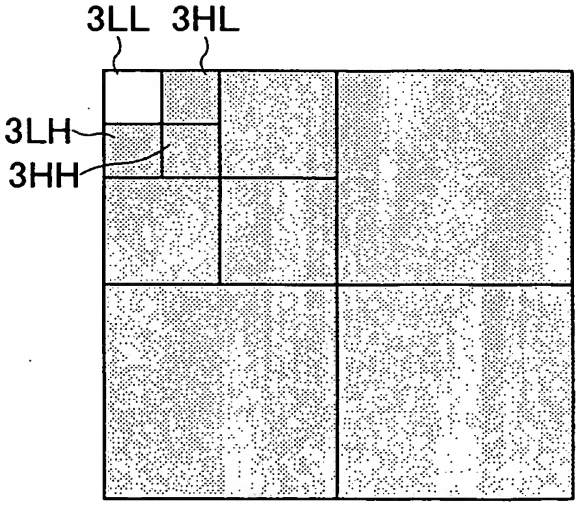
Decomposition_Level_0



Decomposition_Level_1



Decomposition_Level_2



Decomposition_Level_3

FIG.4

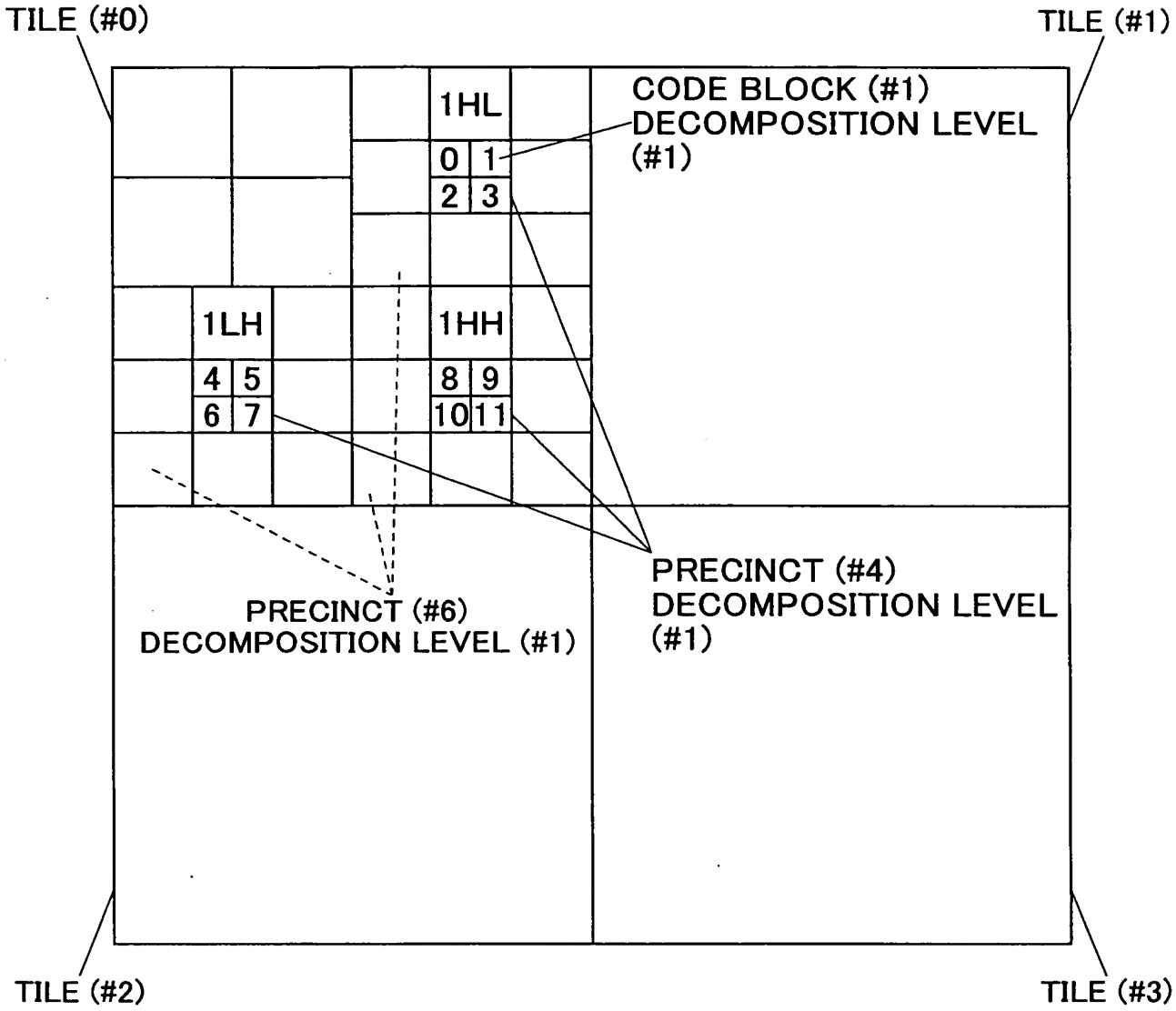

TILE (#0)
TILE (#1)
1HL
0 1
2 3
CODE BLOCK (#1)
DECOMPOSITION LEVEL
(#1)
1LH
4 5
6 7
1HH
8 9
10 11
PRECINCT (#4)
DECOMPOSITION LEVEL
(#1)
PRECINCT (#6)
DECOMPOSITION LEVEL (#1)
TILE (#2)
TILE (#3)

FIG.5A

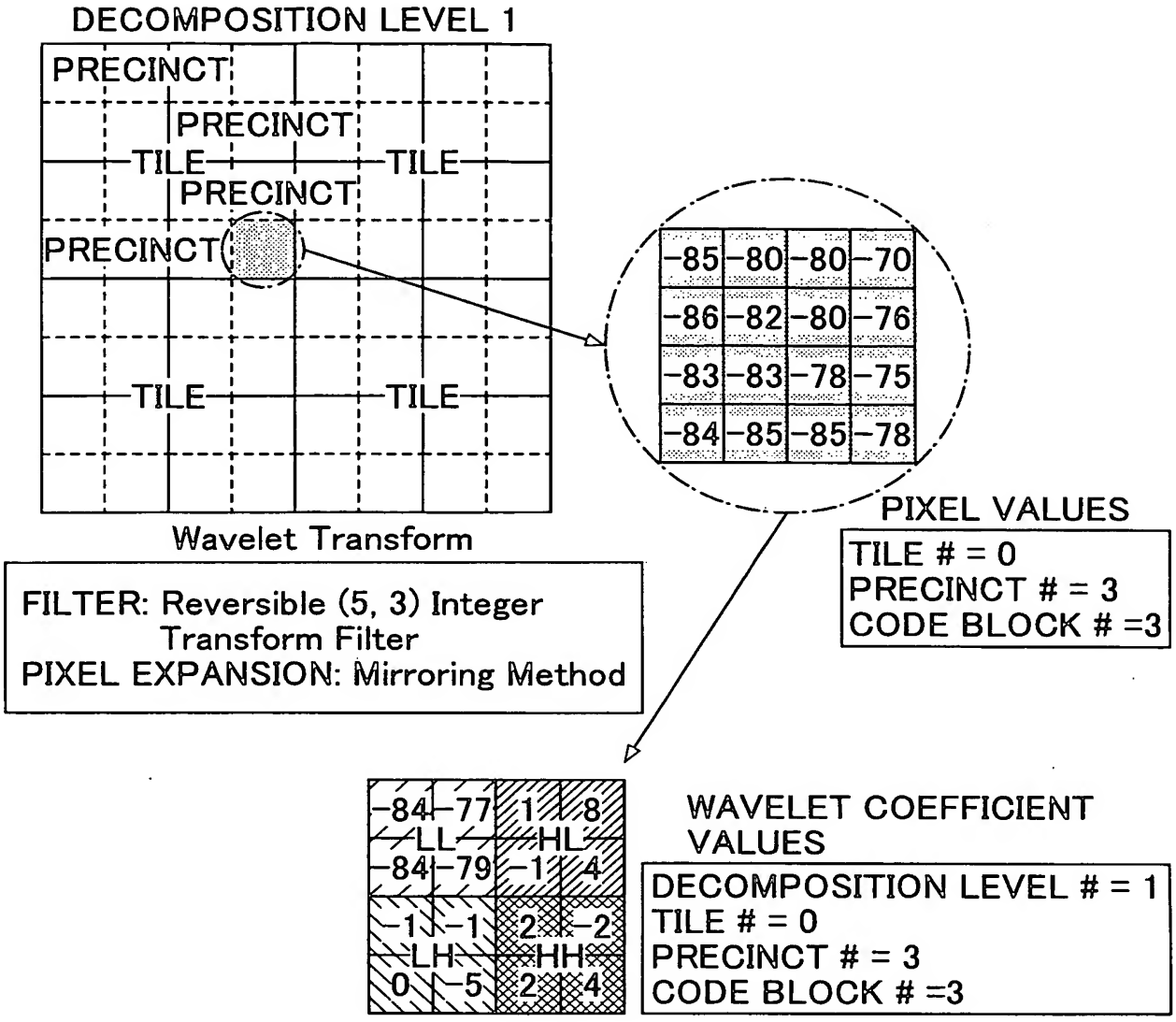

DECOMPOSITION LEVEL 1
PRECINCT
PRECINCT
TILE
TILE
PRECINCT
PRECINCT
TILE
TILE
-85 -80 -80 -70
-86 -82 -80 -76
-83 -83 -78 -75
-84 -85 -85 -78
PIXEL VALUES
TILE # = 0
PRECINCT # = 3
CODE BLOCK # =3
Wavelet Transform
FILTER: Reversible (5, 3) Integer Transform Filter
PIXEL EXPANSION: Mirroring Method
-84 -77 1 8
LL HL
-84 -79 -1 4
-1 -1 2 -2
LH HH
0 -5 2 4
WAVELET COEFFICIENT VALUES
DECOMPOSITION LEVEL # = 1
TILE # = 0
PRECINCT # = 3
CODE BLOCK # =3

FIG.5B

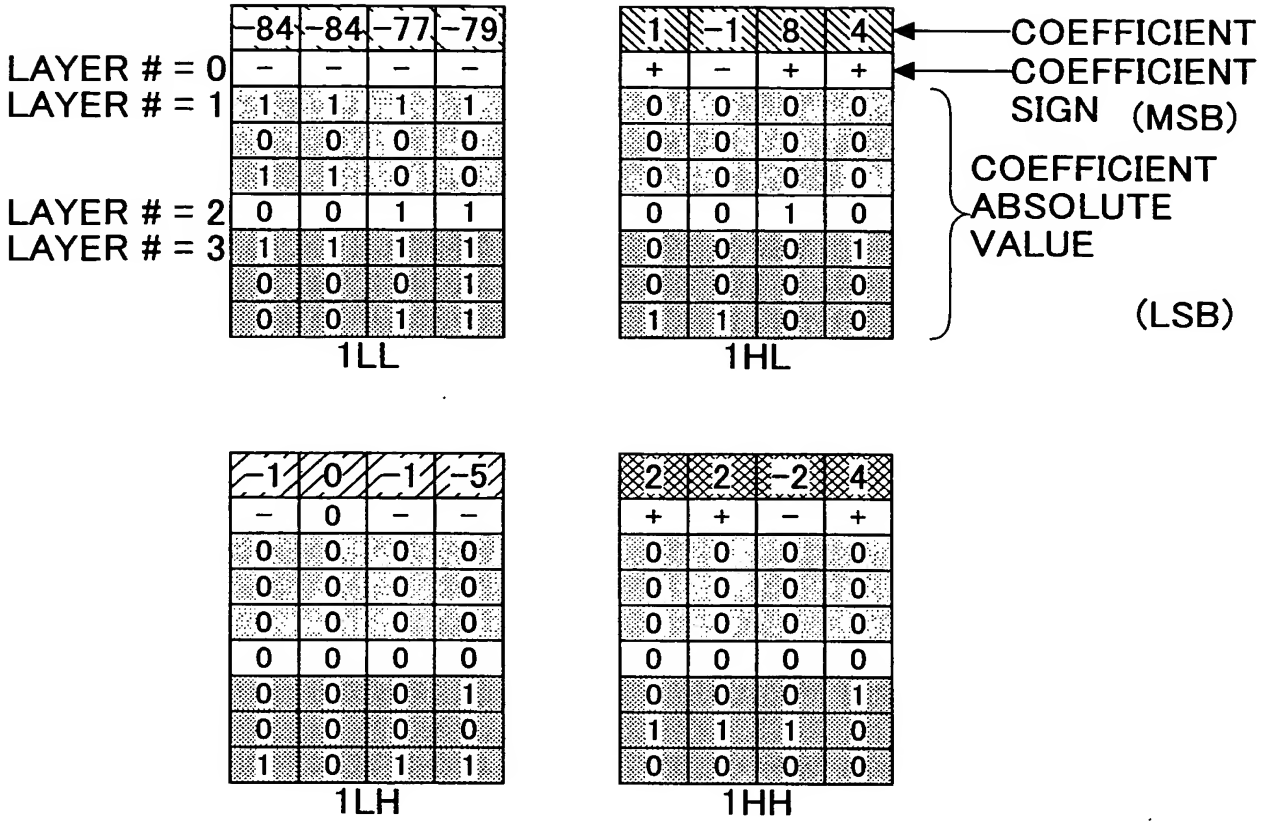

LAYER # = 0
LAYER # = 1
LAYER # = 2
LAYER # = 3
1LL
1HL
COEFFICIENT
COEFFICIENT
SIGN (MSB)
COEFFICIENT
ABSOLUTE
VALUE
(LSB)
1LH
1HH

FIG.6

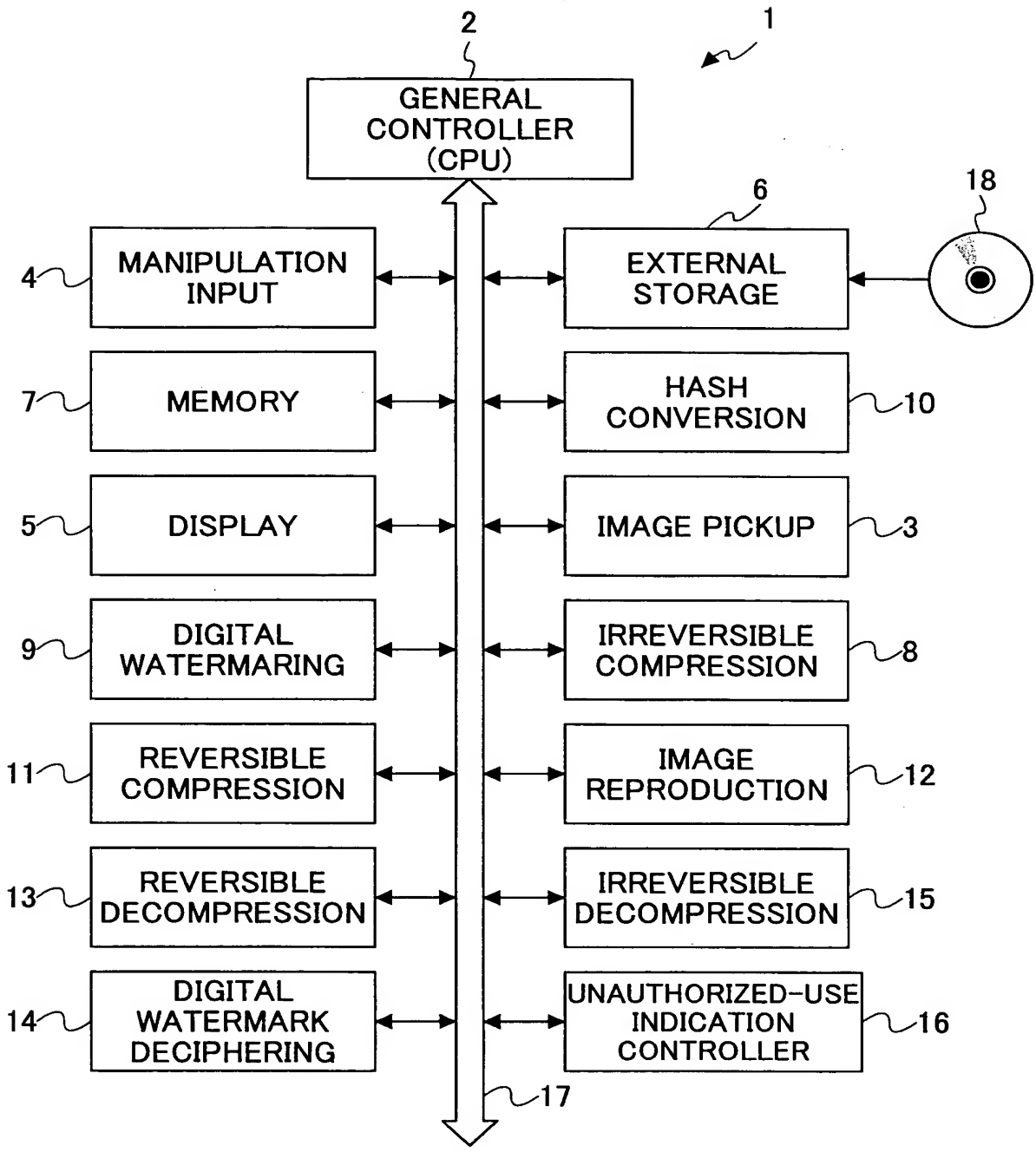

2
1
GENERAL CONTROLLER (CPU)
6
18
4
MANIPULATION INPUT
EXTERNAL STORAGE
7
MEMORY
HASH CONVERSION
10
5
DISPLAY
IMAGE PICKUP
3
9
DIGITAL WATERMARING
IRREVERSIBLE COMPRESSION
8
11
REVERSIBLE COMPRESSION
IMAGE REPRODUCTION
12
13
REVERSIBLE DECOMPRESSION
IRREVERSIBLE DECOMPRESSION
15
14
DIGITAL WATERMARK DECIPHERING
UNAUTHORIZED-USE INDICATION CONTROLLER
16
17

FIG. 7

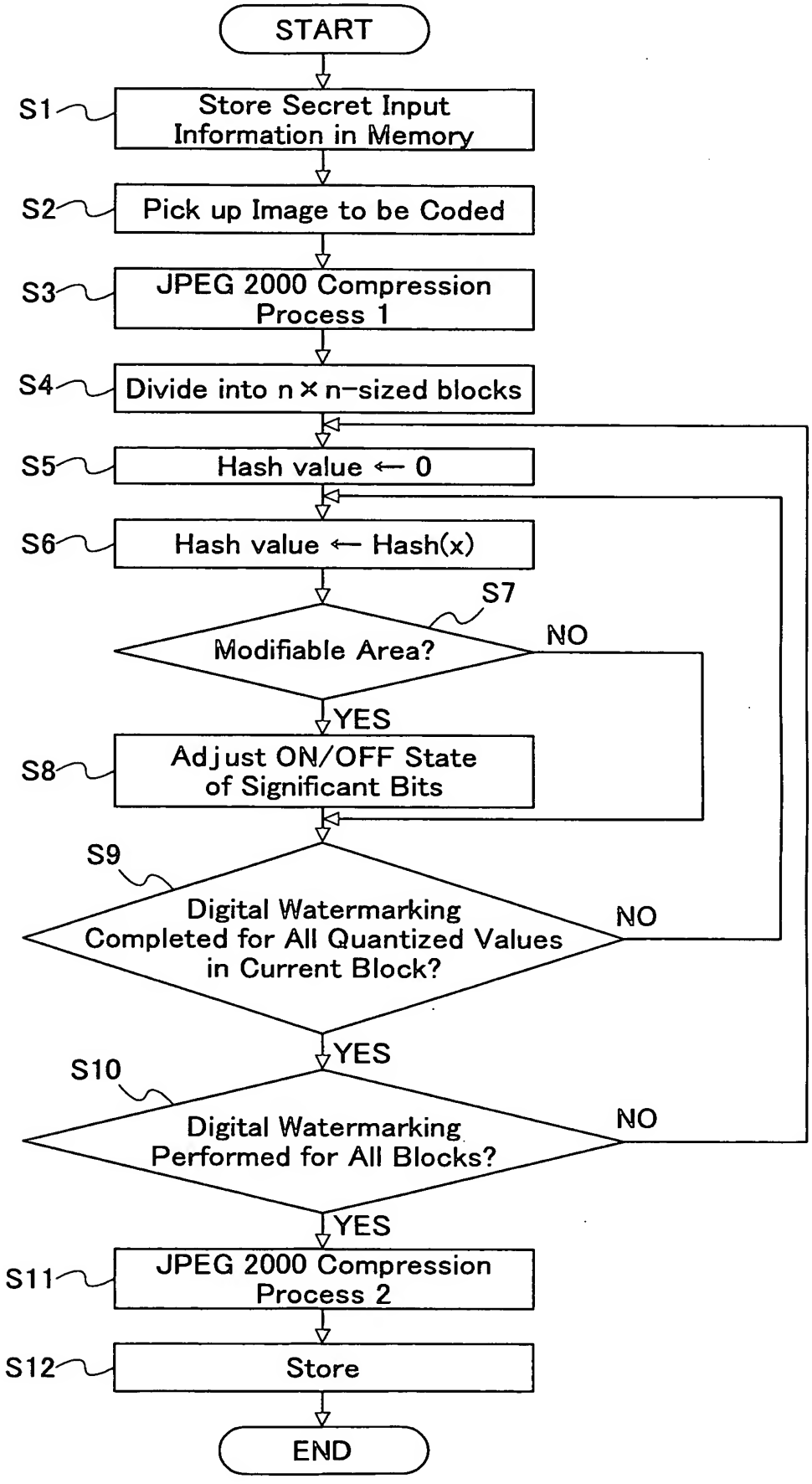

START
S1
Store Secret Input Information in Memory
S2
Pick up Image to be Coded
S3
JPEG 2000 Compression Process 1
S4
Divide into n × n-sized blocks
S5
Hash value ← 0
S6
Hash value ← Hash(x)
S7
Modifiable Area?
NO
YES
S8
Adjust ON/OFF State of Significant Bits
S9
Digital Watermarking Completed for All Quantized Values in Current Block?
NO
YES
S10
Digital Watermarking Performed for All Blocks?
NO
YES
S11
JPEG 2000 Compression Process 2
S12
Store
END

FIG.8B

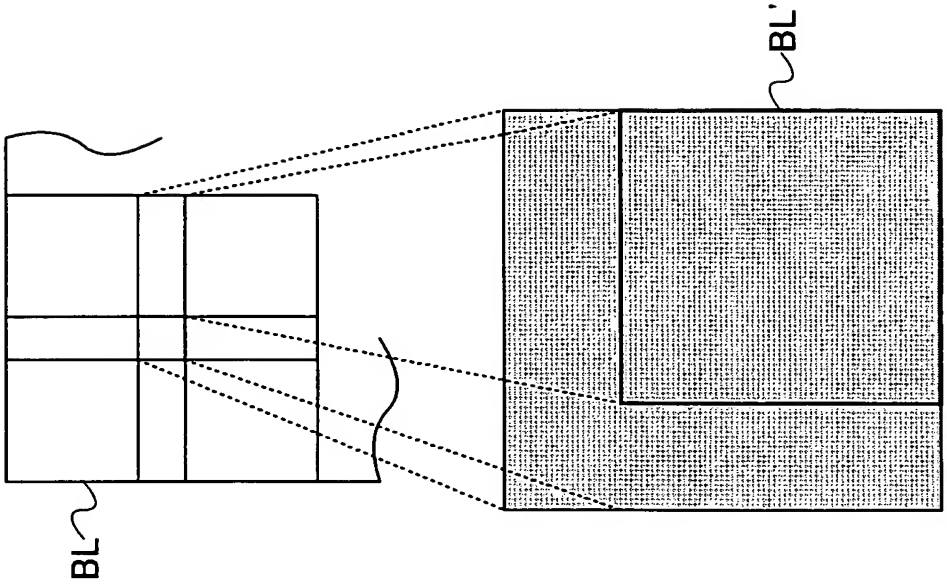


FIG.8A

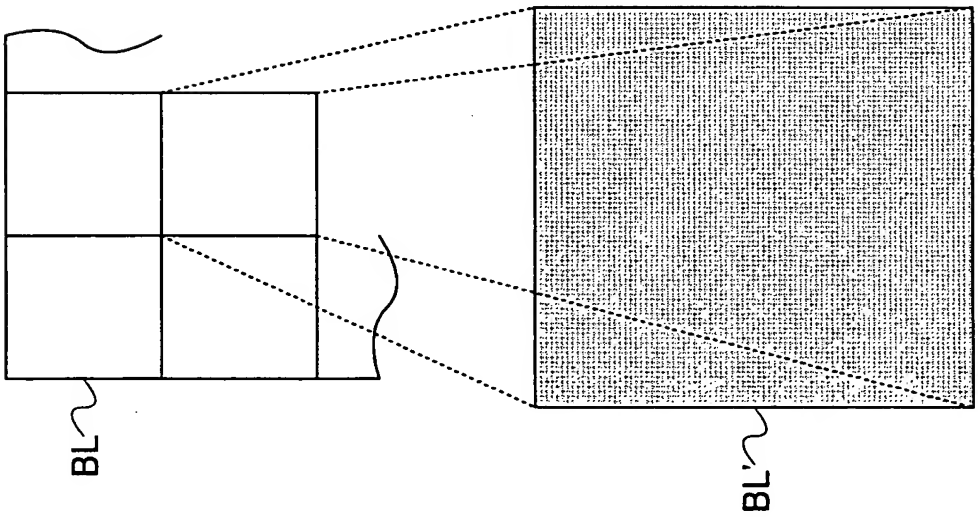


FIG.9

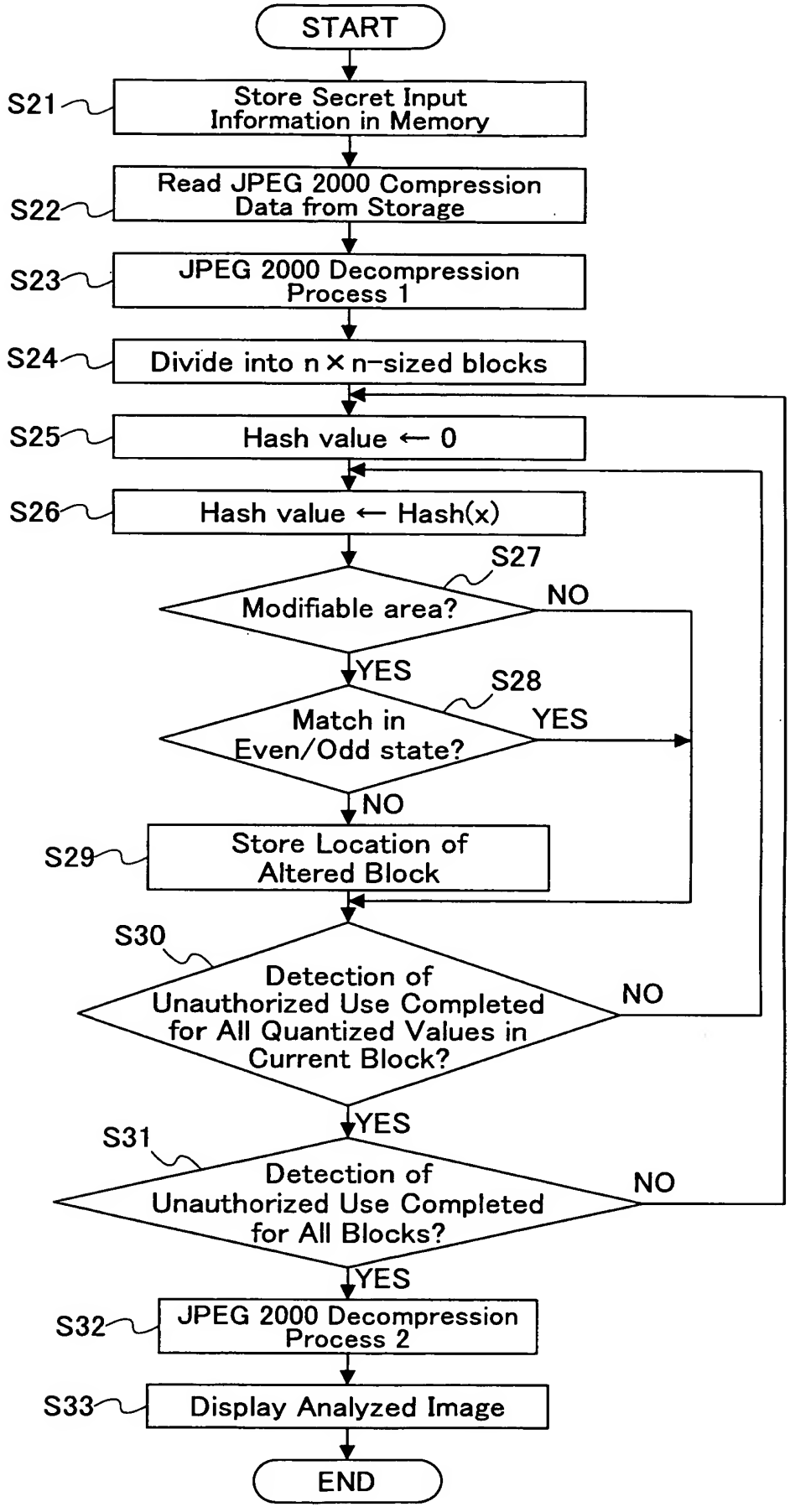

START
S21
Store Secret Input Information in Memory
S22
Read JPEG 2000 Compression Data from Storage
S23
JPEG 2000 Decompression Process 1
S24
Divide into n × n-sized blocks
S25
Hash value ← 0
S26
Hash value ← Hash(x)
S27
Modifiable area?
NO
YES
S28
Match in Even/Odd state?
YES
NO
S29
Store Location of Altered Block
S30
Detection of Unauthorized Use Completed for All Quantized Values in Current Block?
NO
YES
S31
Detection of Unauthorized Use Completed for All Blocks?
NO
YES
S32
JPEG 2000 Decompression Process 2
S33
Display Analyzed Image
END

FIG.10

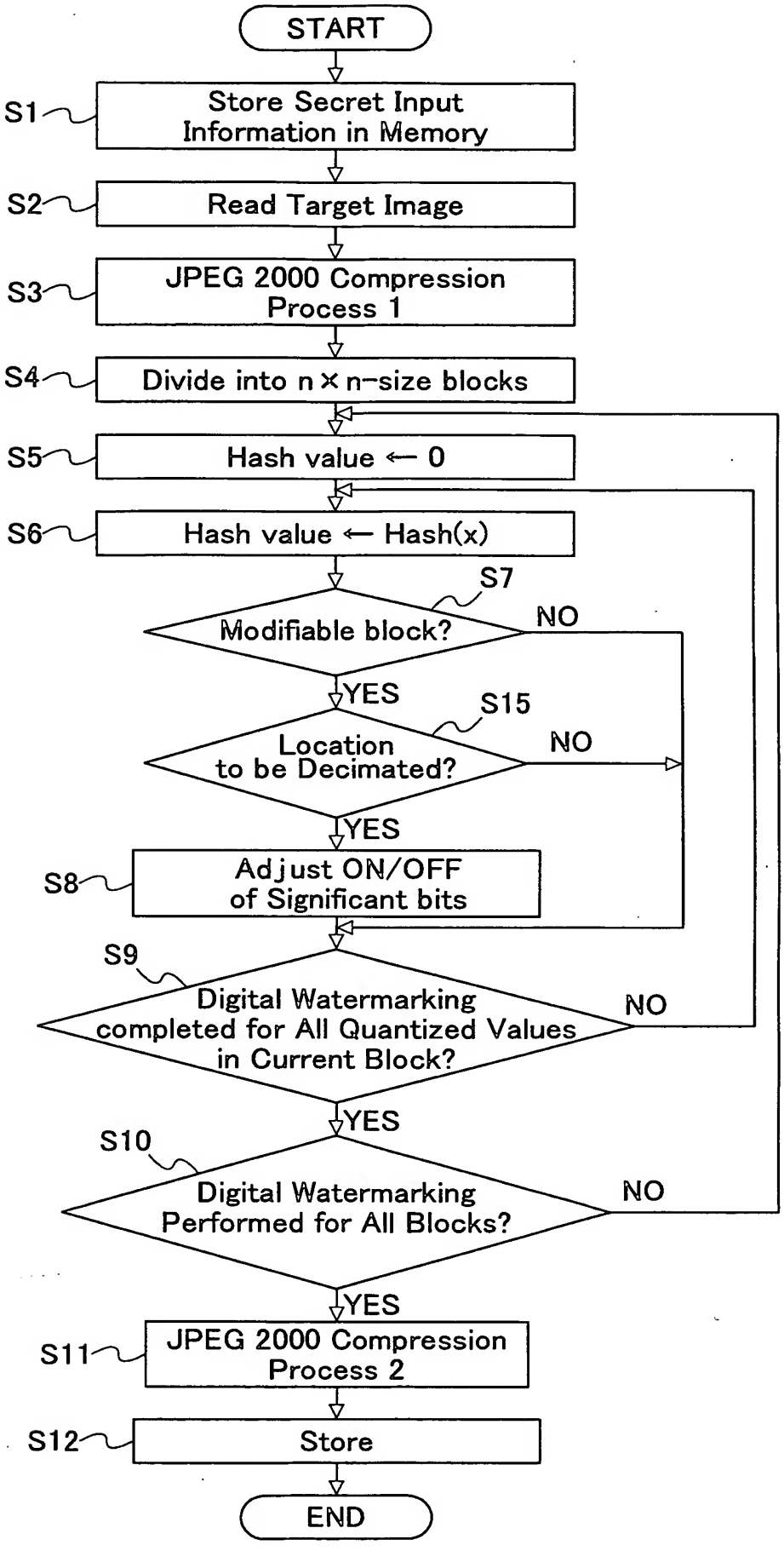
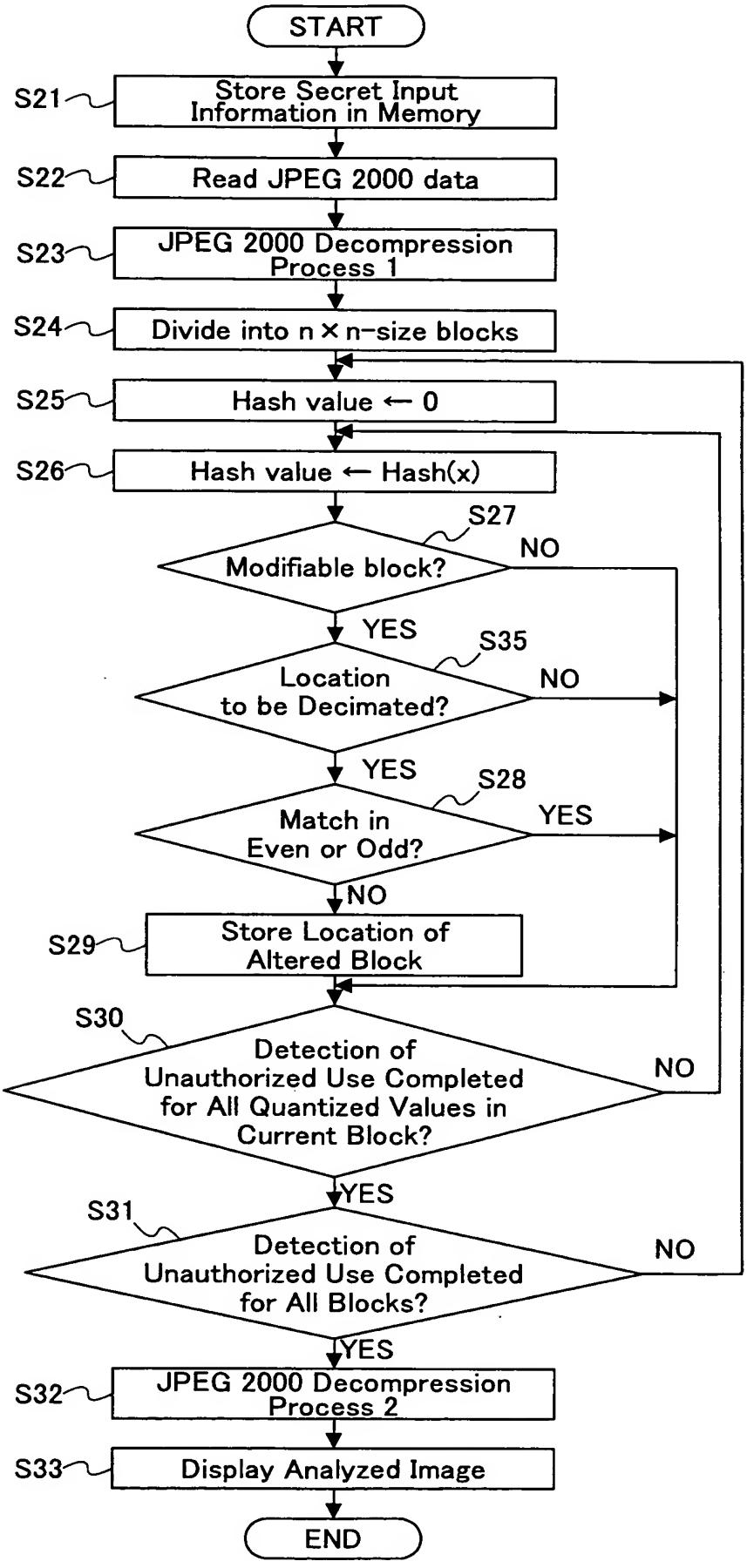

START
S1
Store Secret Input Information in Memory
S2
Read Target Image
S3
JPEG 2000 Compression Process 1
S4
Divide into n × n-size blocks
S5
Hash value ← 0
S6
Hash value ← Hash(x)
S7
Modifiable block?
NO
YES
S15
Location to be Decimated?
NO
YES
S8
Adjust ON/OFF of Significant bits
S9
Digital Watermarking completed for All Quantized Values in Current Block?
NO
YES
S10
Digital Watermarking Performed for All Blocks?
NO
YES
S11
JPEG 2000 Compression Process 2
S12
Store
END

FIG.11


START
S21
Store Secret Input Information in Memory
S22
Read JPEG 2000 data
S23
JPEG 2000 Decompression Process 1
S24
Divide into n × n-size blocks
S25
Hash value ← 0
S26
Hash value ← Hash(x)
S27
Modifiable block?
NO
YES
S35
Location to be Decimated?
NO
YES
S28
Match in Even or Odd?
YES
NO
S29
Store Location of Altered Block
S30
Detection of Unauthorized Use Completed for All Quantized Values in Current Block?
NO
YES
S31
Detection of Unauthorized Use Completed for All Blocks?
NO
YES
S32
JPEG 2000 Decompression Process 2
S33
Display Analyzed Image
END